



TECHNICAL NOTE REPORT No. 1042

**Effect Of Launcher Length
On The Dispersion Of
The 4.5-Inch Rocket M33**

V. KUCHER

DEPARTMENT OF THE ARMY PROJECT No. 5B0305011
ORDNANCE RESEARCH AND DEVELOPMENT PROJECT No. TB3-0240
(TU2-7D)

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VKucher/sdb
Aberdeen Proving Ground, Maryland
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ABSTRACT

A program was conducted to determine the effect of launcher length, in the 3-ft. to 10-ft. domain, on the dispersion of M33 rockets having a clearance with the launcher of from 0.0105 in. to 0.0155 in. The indicated differences among the deflection probable errors and range probable errors obtained are not significant.

INTRODUCTION

The Ballistic Research Laboratories were requested by Rock Island Arsenal to extend their work of investigating the effect of launching conditions on rocket dispersion by including phases closely related to certain weapon-development programs. The firing reported here was conducted as part of a study to determine the effect of length of launcher and bore-clearance on the dispersion of M33 rockets.

DESCRIPTION OF MATERIEL

Launcher Tube

Smooth-bore launcher tube No. 52-37F was used for the entire program. The steel tube has the following dimensions: 4.540" + .001" I.D., 5" O.D., and 10-ft. length.

In order to eliminate changes in the I.D. of the tube which are caused by the heat of the exhaust gases of the rockets during firing, the tube was covered by a water jacket through which water was circulated during the test.

Ammunition

4.5-inch Rockets M33 (T161E5), Lot No. PA-E-17378, were used in the program. Each rocket was fitted with Inert Fuze M51A5. The specifications for the test rockets called for 4.5280" - .0005" bourrelets.

Launcher Mount

A concrete block which is located at Launcher Position No. 2 on Spesutie Island was used as a launcher mount in an effort to minimize any launcher movement.

Surface Wind Instrumentation

Horizontal wind velocity was measured with an Aerovane Model 510072-1 anemometer, which consists of a three-blade rotor for measuring wind speed and a streamlined vane for indicating wind direction. The anemometer was located a few feet from the launcher site.

DETAILS OF THE PROGRAM

Procedure

A water jacket was assembled over the smooth-bore launcher tube No. 52-37F and the complete assembly was rigidly mounted on the concrete block at an elevation of 306 mils.

The rockets were temperature conditioned at 70°F for at least 24 hours prior to firing.

The program was fired from one tube, but by inserting the rockets in the tube at distances of 0 ft., 4 ft., and 7 ft. from the breech, three launcher lengths of 10 ft., 6 ft., and 3 ft. were effectively used. This procedure minimized variations in launcher-tube inside diameter, elevation, and azimuth which may have resulted if three different tubes were used for each length.

In order to learn whether this procedure introduced differences in muzzle velocity, a preliminary experiment was conducted. Five M33 rockets were fired from a 3-ft. smooth-bore launcher and five M33 rockets were fired from a simulated 3-ft. smooth-bore launcher that was 10 ft. long. The average velocities were 148.8 fps and 148.5 fps respectively, at a distance of 16 inches from the muzzle. The experiment was repeated using 6-ft. launcher lengths. The average velocities at 16 inches from the muzzle were 187.6 fps for the 6-ft. launcher and 190.5 fps for the simulated 6-ft. launcher that was 10 ft. long. In each case the indicated difference in velocity is not significant at the 5% level of significance.

The firing of the program began on 14 March 1955. In the morning, 30 rockets, M33, were fired using the 10-ft., 6-ft., and 3-ft. launcher lengths in that order. In the afternoon, 6 rockets were fired using the 6-ft. length; however, a haze which had appeared over the impact area hampered the observation of the impacts of the rockets. These 6 rockets are not recorded in the results. The program was discontinued until 31 March 1955 when the remainder of the program was fired. The launcher

setup was not disturbed in the meantime. Since 24 test rockets remained, 8 rockets each were fired using the 6-ft., 3-ft., and 10-ft. lengths respectively.

The rockets were fired for water impact. At least three observers using transit theodolites observed the impacts, the locations of which were determined by triangulation. A Range-Firing Summary is included in Appendix I.

When each rocket was fired, surface wind data at the launching site were recorded. These data are included with the Range-Firing Summary, Appendix I. Also, meteorological data were recorded throughout the program by the Meteorological Branch, Development and Proof Services. These data are included in Appendix II.

The launcher tube was star-gaged by the Physical Test Laboratory, Development and Proof Services, before and after the program.

Results

The results of the program are tabulated below:

<u>Launcher Length (ft)</u>	<u>No. of Rockets</u>	<u>Deflection Mean (μ)</u>	<u>Deflection P.E. (μ)</u>	<u>Range Mean (yds)</u>	<u>Range P.E. (yds)</u>
3	18	2.4	5.4	6200	110
6	16	10.4	6.9	6183	105
10	15	14.9	8.0	6294	75

The specifications for machining the bourrelets of the rockets would have resulted in a bore-clearance of 0.0120 in. to 0.0135 in.; however, the tolerance on the bourrelets was not held in machining so that a bore-clearance of 0.0105 in. to 0.0155 in. resulted.

The star-gage records show no effects on the launcher tube as a result of firing.

CONCLUSIONS

The indicated differences among the deflection probable errors and range probable errors are not significant at the 5% level. If there is an effect of launcher length in the 3-ft. to 10-ft. range of length with a 0.0105-in. to 0.0155-in. bore-clearance, the number of rockets fired in the program was too small to reveal this effect.

A handwritten signature in cursive script, appearing to read 'V. Kucher', is centered on the page.

V. KUCHER

APPENDIX I

RANGE FIRING SUMMARY

Date: 14 March 1955

<u>Rocket Number</u>	<u>Launcher Length (ft)</u>	<u>Time</u>	<u>Deflection</u>		<u>Range Yards</u>	<u>Wind</u>	
			<u>Mils</u>	<u>Yards</u>		<u>Direction (Degrees)</u>	<u>Velocity (mph)</u>
1	10	1109	24.6	148	6159	315	1
2	10	1111	4.5	28	6451	300	3
3	10	1113	33.8	204	6155	290	2
4	10	1115	47.2	288	6226	290	3
5	10	1116	Lost	--	--	270	3
6	10	1117	24.1	145	6122	250	3
7	10	1118	10.0	62	6348	270	4
8	10	1120	29.9	184	6277	--	0
9	10	1122	Lost	--	--	240	1
10	10	1124	15.6	94	6126	250	2
11	6	1126	16.2	95	6013	270	2
12	6	1128	15.2	91	6087	270	2
13	6	1130	13.9	82	5989	270	1
14	6	1132	1.2	7	6149	--	0
15	6	1134	21.6	129	6114	--	0
16	6	1136	23.1	131	5782	--	0
17	6	1138	6.9	40	5981	240	1
18	6	1139	26.0	153	6002	270	1
19	6	1140	2.8L	17L	6054	--	0
20	6	1141	Lost	--	--	--	0
21	3	1142	2.3	14	6104	--	0
22	3	1143	3.0	19	6363	--	0
23	3	1144	8.5	49	5942	--	0
24	3	1146	5.0L	30L	6204	--	0
25	3	1148	5.5	34	6253	--	0
26	3	1150	9.9	61	6261	--	0
27	3	1152	6.8L	42L	6289	--	0
28	3	1153	6.8	39	5916	--	0
29	3	1155	9.2	54	6032	--	0
30	3	1156	8.4	49	5959	300	1

Date: 31 March 1955

37	6	1103	1.4	9	6342	65	12
38	6	1104	16.8	102	6212	90	11
39	6	1105	2.9	19	6691	80	11
40	6	1106	5.3L	32L	6158	90	12
41	6	1108	Lost	--	--	90	13
42	6	1115	1.2	8	6607	60	12
43	6	1116	17.8	113	6476	80	5
44	6	1130	10.2	63	6270	60	13
45	3	1131	14.7L	94L	6507	90	10
46	3	1132	3.2L	19L	6121	90	9

APPENDIX I CONTINUED

Rocket Number	Launcher Length (ft)	Time	Deflection		Range Yards	Wind	
			Mils	Yards		Direction (Degrees)	Velocity (mph)
47	3	1134	8.2	49	6054	60	13
48	3	1136	9.1L	55L	6171	90	12
49	3	1140	17.8	111	6339	90	16
50	3	1146	1.2L	7L	6228	90	16
51	3	1150	0.4	3	6409	60	10
52	3	1151	2.1	13	6450	60	5
53	10	1152	2.2L	14L	6333	90	10
54	10	1153	12.2L	77L	6400	60	10
55	10	1154	7.2	45	6448	60	13
56	10	1155	14.6	88	6177	60	13
57	10	1156	Lost	--	--	90	12
58	10	1157	11.0	70	6458	90	10
59	10	1158	11.3	70	6289	60	10
60	10	1200	3.6	23	6434	60	11

Note: "L" after deflection indicates left of line of fire.

Wind directions were measured counterclockwise from the line of fire.

APPENDIX II

Meteorological Data

Date: 14 March 1955

Wind Data Aloft

Time of Balloon Release: 1120

<u>Time Observed</u> <u>Mins.</u>	<u>Altitude</u> <u>yds.</u>	<u>W_x</u> <u>mph</u>	<u>W_z</u> <u>mph</u>
0	0	0.0	0.0
1	332	+3.6	+5.4
2	500	+7.0	+2.8
3	692	+5.3	-2.6

Surface Data

Sky: Clear	Temperature: 44.0°F	Line of Fire: 28°38'
Visibility: Good	Pressure: 30.41 in.	Wind Direction (To): --
Ballistic Density: 1.064	Relative Humidity: 54%	Wind Velocity (mph): Calm

Wind Data Aloft

Time of Balloon Release: 1218

<u>Time Observed</u> <u>Mins.</u>	<u>Altitude</u> <u>yds.</u>	<u>W_x</u> <u>mph</u>	<u>W_z</u> <u>mph</u>
0	0	-1.0	+4.9
1	211	-1.1	+5.9
2	449	+3.5	+4.3
3	624	+5.3	-0.8
4	868	-0.7	-4.7

Surface Data

Sky: Clear	Temperature: 45.5°F	Line of Fire: 28°38'
Visibility: Good	Pressure: 30.39 in.	Wind Direction (To): 310°
Ballistic Density: 1.060	Relative Humidity: 54%	Wind Velocity (mph): 5

Temperatures and Densities Aloft

Radio Meteorograph:

Time Released: 1158

Time Reached Altitude: 1200

<u>Altitude Yards</u>	<u>Temperature °F</u>	<u>Relative Density</u>
0	44.8	1.062
175	36	1.079
351	34	1.079
530	31	1.082
712	33	1.073

APPENDIX II (CONTINUED)

Date: 31 March 1955

Wind Data Aloft

Time of Balloon Release: 1119

<u>Time Observed</u> <u>Mins.</u>	<u>Altitude</u> <u>yds.</u>	<u>W_x</u> <u>mph</u>	<u>W_z</u> <u>mph</u>
1/2	0	+3.4	-11.5
1	414	+6.5	-12.3
2	848	+6.6	-13.0

Surface Data

Sky: Clear Temperature: 54°F Line of Fire: 28°38'
 Visibility: Good Pressure: 30.19 in. Wind Direction (To): 135°
 Ballistic Density: 1.036 Relative Humidity: 35% Wind Velocity (mph): 12

Wind Data Aloft

Time of Balloon Release: 1211

<u>Time Observed</u> <u>Mins.</u>	<u>Altitude</u> <u>yds.</u>	<u>W_x</u> <u>mph</u>	<u>W_z</u> <u>mph</u>
1/2	0	+2.2	-10.8
1	320	+0.8	-14.7
2	546	+1.2	-15.5
3	774	+3.0	-14.6

Surface Data

Sky: Clear Temperature: 56.5°F Line of Fire: 28°38'
 Visibility: Good Pressure: 30.13 in. Wind Direction (To): 130°
 Ballistic Density: 1.028 Relative Humidity: 37% Wind Velocity (mph): 11

Temperatures and Densities Aloft

Radio Meteorograph:

Time Released: 1105

Time Reached Altitude: 1107

<u>Altitude Yards</u>	<u>Temperature °F</u>	<u>Relative Density</u>
0	53.1	1.038
179	45	1.052
359	42	1.055
542	39	1.059
728	37	1.059

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